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Effect of dislocation structure on the strain rate dependence of the flow stress in a 2D discrete dislocation dynamics model HENGXU SONG, Univ of Groningen, STEFANOS PAPANIKOLAOU , Johns Hopkins University, ERIK VAN DER GIESSEN, Univ of Groningen — It is well known for almost three decades that crystal plasticity in metals, such as Cu, is strongly rate dependent at strain rates higher than 10ˆ3/s. This rate sensitivity is typically attributed to dislocation drag effects, but there appears to be a large range of possible high-rate-sensitivity exponents, depending on the sample and the experimental group. Thus, one may hypothesize that the dislocation structure has a strong influence on these effects. We elucidate the origins of rate effects in crystal plasticity and their connection with relaxed, before applying stress, dislocation structures by investigating simple bending in a model of discrete dislocation plasticity in two dimensions. We find that the high-strain-rate sensitivity changes significantly as a function of strain, different material treatment (annealed or not) and properties of dislocation sources (surface vs. bulk nucleation). We characterize in detail the emerging patterning in the dislocation structure and we provide predictions for future experiments on the dependence of the rate sensitivity on dislocation-related characteristics.

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